PISCATAQUA RIVER BASIN

ROCHESTER, NEW HAMPSHIRE

BAXTER LAKE EASTERLY DIKE

NH 00391

STATE NO 204.09

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1978

UNCLASSIFIED

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Y WORDS *(Continue on reverse side if necessary and identify by block number)*

MS, INSPECTION, DAM SAFETY,

Piscataqua River Basin
Rochester New Hampshire
Hickers Brook

STRACT *(Continue on reverse side if necessary and identify by block number)*

The dam is about 8 ft. high and is 340 ft. long. It is an earthen embankment containing an 18 inch cutoff wall with rather steep faces. The dike is in poor condition with major concerns which need attention. The dike has no outlet. The test flood would overtop the dike by 2.1 ft.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

Honorable Meldrim Thomson, Jr.
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

NOV 28 1978

Dear Governor Thomson:

I am forwarding to you a copy of the Baxter Lake Easterly Dike Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Mr. Harry Baxter, Baxter Lake, Rochester, New Hampshire 03867.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

BAXTER LAKE EASTERLY DIKE

NH 00391

PISCATAQUA RIVER BASIN
ROCHESTER, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH00391
Name of Dam:	Baxter Lake Easterly Dike
City:	Rochester
County and State:	Strafford County, New Hampshire
Stream:	Rickers Brook
Date of Inspection:	14 June 1978

BRIEF ASSESSMENT

Baxter Lake Easterly Dike is about 8 feet high, averages about 9 feet wide, and is 340 feet long. It is an earthen embankment containing an 18-inch cutoff wall with rather steep faces (1½H:1V side slopes). The upstream face was originally riprapped. Today the upstream face is ragged, but the dike generally resembles these dimensions. The impoundment of Baxter Lake is provided by the Main Dam and three dikes, Easterly, Center, and Westerly. The lake is 1 mile long, has a surface of more than 300 acres, and is used now for recreation. Maximum storage is 1,720 acre-feet.

The dike is in poor condition. Major concerns with regard to the overall integrity include extensive seepage along the downstream toe of the dike, very small freeboard at the east abutment and lower land beyond the abutment, and trees and brush growing on both upstream and downstream faces of the dike. The small freeboard combined with the inadequate spillway of the Main Dam and the historical record of overtopping, breaching, and rebuilding all lend support to these concerns.

The dike has no outlet. The test flood would overtop the dike by 2.1 feet.

The owner, Mr. Harry Baxter, within one year, should retain the services of a registered professional engineer and implement the results of his evaluation of the following: assess the necessary freeboard requirements of the Easterly Dike based on the hydrology of the Baxter Lake drainage area and the capacity of the spillway and gated outlet at the Main Dam and design the remedial measures for eliminating and/or controlling the seepage at the downstream toe of the dike. Within six months, the owner should implement the following operational and maintenance measures: monitor the seepage weekly, cut brush on the dike and brush and trees downstream for 25 feet and keep these areas clear, and establish, in conjunction with the owner of the other structures impounding Baxter Lake, a surveillance and warning program to be exercised during floods.

Warren A. Guinan

Warren A. Guinan
Project Manager
N.H. P.E. No. 2339

This Phase I Inspection Report on the Baxter Lake Easterly Dike Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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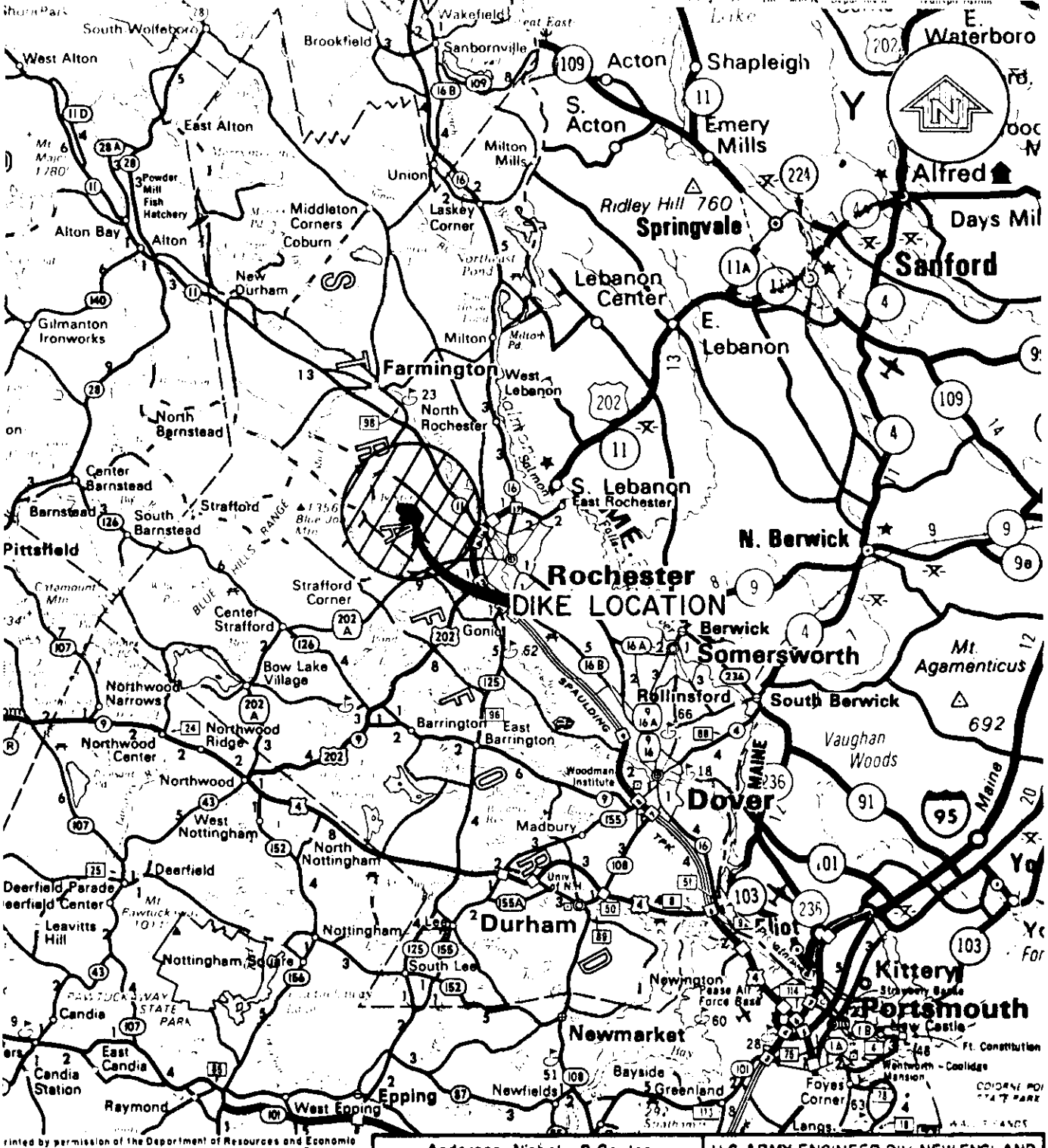
Figure 1 - Overview of the upstream face of the dike.



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SCALE IN MILES

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AP BASED ON STATE OF NEW HAMPSHIRE-TATE OF MAINE OFFICIAL HIGHWAY MAPS.

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BAXTER LAKE EASTERLY DIKE LOCATION MAP

BAXTER LAKE NEW HAMPSHIRE

			SCALE: 1" = 5 MI
			DATE: JULY 1978

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
BAXTER LAKE EASTERLY DIKE

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols & Company, Inc. under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0329 has been assigned by the Corps of Engineers for this work.

b. Purpose.

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Baxter Lake is located in the City of Rochester and the Town of Farmington, New Hampshire. Baxter Lake Easterly Dike, along with Center and Westerly Dikes and Main Dam, form the impounding structures creating Baxter Lake. These structures are all located in Rochester, New Hampshire. Baxter Lake forms the headwaters of Rickers Brook which is confluent with Howard Brook approximately 3 miles downstream. These two brooks combine to form Axe Handle Brook which flows 1.3 miles to its confluence with the Cocheco River just north of Gonic, New Hampshire. The Cocheco River then flows southeasterly for a distance of about 16 miles to its confluence with the Piscataqua River. The Cocheco River is a major

tributary in the Piscataqua River Basin. Baxter Lake Easterly Dike is shown on U.S.G.S. Quadrangle, Alton, New Hampshire, with coordinates approximately at N 43° 19' 12", W 71° 02' 06", Strafford County, New Hampshire. (See Location Map page iv.)

b. Description of Dam and Appurtenances. Baxter Lake Easterly Dike is an earthen embankment covering an 18-inch concrete core wall. A design drawing indicates that the dike, as originally constructed, was 340 feet long. The core wall was about 6 inches below the earth cover and was about 310 feet long, 20 feet short of the west end and 10 feet short of the east end of the dike. At its maximum height above natural ground, the core wall was about 8.5 feet high, and extended downward an unspecified depth, to what was referred to as "impervious material." (See Section 2.) The original construction probably had 1½H:1V side slopes; the upstream face was riprapped. The field inspection generally verified that the visual aspects today resemble the originally constructed dike.

c. Size Classification. Intermediate (Hydraulic Height - 8 feet, Storage - 1,720 acre-feet) based on storage ($\geq$ 1,000 to $<$ 50,000 acre-feet) as given in OCE Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant hazard. A major breach would result in the loss of less than 10 lives and little downstream property damage.

e. Ownership. Baxter Lake Easterly Dike, along with the Main Dam and Center Dike, were originally constructed in 1923 by the Gonic Manufacturing Company for the purpose of storage for hydroelectric generation as well as textile process water. Today, Mr. Harry Baxter, a long time resident of Baxter Lake, owns the Easterly Dike. The ownership during this intervening period is not known.

f. Operator. Mr. Harry Baxter, Baxter Lake, Rochester, New Hampshire 03867, is the present owner of the Easterly Dike. The water level of the lake, however, is controlled by the operator of the Main Dam. (See Baxter Lake Main Dam report.)

g. Purpose of Dam. Baxter Lake Easterly Dike, as well as the Main Dam and Center Dike, were originally constructed to provide an impoundment for industrial water for the Gonic Manufacturing Company in Gonic, New Hampshire. Baxter Lake was utilized as upstream storage for hydroelectric generation as well as textile process water. After 1959 its use was strictly as textile process water. Today, Baxter Lake is utilized for recreational purposes only.

h. Design and Construction History. L. E. Scruton, C. E., Portsmouth, New Hampshire, designed the Main Dam and two dikes in 1921 and supervised the construction in 1922-23. A design plan and inspection reports show that the structure is an earthen dike with a concrete core wall. A sketch of repairs dated 1935 reflects a 10 foot + vertical upstream face comprised of rounded boulders with hardpan fill. In May, 1954, the easterly end of the dike washed out. The New Hampshire Water Resources Board (NHWRB) inspected the dike at that time and recommended that it be raised by 2 feet and the downstream slope flattened to 2H:1V. There is no evidence of these recommendations having been carried out. Today the Easterly Dike is low and the upstream face is raveling.

i. Normal Operational Procedures. Not applicable; Baxter Lake Easterly Dike has no outlet facilities. No written maintenance procedures were disclosed.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 4 square miles (2,560 acres) of gently to steep-sloping wooded terrain.

b. Discharge at Dike

(1) Outlet works (conduits) - none

(2) The maximum known discharge at dike is unknown.

(3) Ungated spillway capacity at maximum pool elevation - not applicable

(4) Gated (stoplog) spillway capacity at recreational pool elevation - not applicable

c. Elevation (ft. above MSL)

(1) Top of dike - 414

(2) Maximum pool - design surcharge - unknown

(3) Full flood control pool - not applicable

(4) Recreation pool - 413

(5) Spillway crest - not applicable

(6) Upstream portal invert diversion tunnel - none

(7) Streambed at centerline of Main Dam - 406.7 (downstream toe as measured at time of inspection)

(8) Maximum tailwater - unknown

d. Reservoir (miles)

(1) Length of maximum pool - 1.0

(2) Length of recreational pool - 1.0

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 1,400

(2) Flood control pool - not applicable

(3) Design surcharge - unknown

(4) Top of dike - 1,720

f. Reservoir Surface (acres)

(1) Top of dike - 324

(2) Maximum pool - 324

(3) Flood control pool - not applicable

(4) Recreation pool - 316

(5) Spillway crest - not applicable

g. Dike

(1) Type - earthen embankment with concrete core

(2) Length - 340'

(3) Height - 8'

(4) Top Width - 7'-10'

(5) Side Slopes - About 2H:1V

(6) Zoning - unknown

(7) Impervious Core - 18-inch concrete core wall

(8) Cutoff - concrete core wall extends to unknown depth.

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - not applicable

i. Spillway - none

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for the structures impounding Baxter Lake.

2.2 Construction

Except for inspection reports and design drawings noted below, few other construction data were disclosed for the impounding structures on Baxter Lake. A search of the files of the NHWRB revealed three blueprint design plans dated 1921 and a plan of the reconstruction completed in 1942.

During construction in 1922, the following quotations, taken from reports by B. H. Moxon, State Inspector, were obtained from the files of the NHWRB, successor agency to the Public Service Commission of New Hampshire, the State Agency that was responsible in 1922 for approving plans and making inspections of dam construction:

> On Thursday, May 25, 1922, I made an inspection of the several locations where the Gonic Manufacturing Company intend to construct a dam and two dikes. The natural geographical conditions are such that a storage reservoir may be easily obtained.
>
> The site of the Main Dam is just upstream from an old rock-filled dam which was in use probably 75 years ago. It is expected that ledge foundation will be met for the whole distance of the Main Dam. Plans and specifications for this development are on file in the office of the Public Service Commission.
>
> L.E. Scruton of Portsmouth is the engineer and contractor, and the work is being done under contract. The foundation for the Main Dam was not exposed, but an examination

> of the cut-off trenches for the dike walls showed that sufficiently impervious foundation was encountered on which to build the concrete cut-offs. The engineer was advised that he could proceed with the work as fast as possible, but was to advise us at such time as the foundation for the Main Dam was cleared. It is expected that a concrete mix of 1-2½-5 would be used on this work, the gravel being natural run of the bank and testing to that ratio. (Inspection 5/25/22)

On 4/28/23, Gonic Manufacturing Company informed the Public Service Commission that the work was complete and the pond was filled. (See Appendix B.)

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Little engineering data were disclosed for the structures impounding Baxter Lake. A search of the files of the NHWRB revealed only a limited amount of recorded information.

b. Adequacy. Because of the limited amount of detailed data available, the final assessments and recommendations of this investigation are based on visual inspection and hydrologic and hydraulic calculations.

c. Validity. The plans found for the construction in 1921-1922 and rehabilitation completed in 1942 are in general conformity with the structure as seen in the visual inspection. (For details, see Sections 3 & 6 and Appendix B.)

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The Easterly Dike is a small dike in height but is classified as intermediate because of the size of the impoundment of Baxter Lake. The downstream area is gently sloping and heavily wooded. The watershed above the reservoir is gently to steeply sloping and heavily wooded. There are some cottages, homes and trailers around the perimeter of the reservoir. The lake level is controlled at the Main Dam. The owner's home is located about 150 feet east of the east abutment. A low swale in the land lies just beyond this abutment.

b. Dike. The Easterly Dike is the lowest of the four impoundment structures on Baxter Lake. The dike consists of an earthen embankment totaling 340 feet in length. The crest of the dike ranges in width from 7 feet to 10 feet, and ranged from 1.1 to 1.7 feet above the water surface as measured at the time of inspection. (See Appendix C - Figure 2.) The lowest point (1.1') is located approximately 15 feet east of the earthen embankment in natural ground. The upstream side has been faced with riprap. (See Appendix C - Figure 3.) The downstream slopes are covered with low brush and vegetation. The slope on the downstream face is approximately 2H:1V and the maximum height of the dike above the downstream valley is approximately 8 feet. (See Appendix C - Figure 4.)

Extensive seepage was observed along the entire length of the dike, with higher concentrations at the easterly end. (Estimated discharge 0.04 cfs) (See Appendix C - Figure 5.) The crest of the dike has a path about 3 feet wide that has been worn bare by foot traffic. Several tree roots, transverse to the axis of the dike, are exposed at the surface in the footpath. Trees are growing immediately downstream of the downstream toe of the dike. Numerous trees on the downstream face have been cut, leaving tree stumps ranging up to 8 inches in diameter.

c. Appurtenant Structures. There are no apparent structures on the Easterly Dike.

d. Reservoir Area. The reservoir slopes are gently to steeply sloping and covered with trees and brush. Homes, cottages and trailers are scattered along the shoreline. All are sited 3 or 4 feet higher than the dike. (See Appendix C - Figure 6.)

e. Downstream Channel. No defined stream channel exists downstream of the dike since there are no outlet works at the dike. The valley downstream of the dike is broad and gently sloping, and is covered with trees and brush.

3.2 Evaluation

Based on the visual inspection, the condition of the Easterly Dike on Baxter Lake is poor.

Seepage is extensive along the downstream toe of the dike. Although it was reported by the owner of the dike that this seepage had been occurring for many years, the extent of the seepage is so great that it has to be a concern.

The freeboard is only one foot at the east end of the dike. A previous inspection report dated 1954 indicated that the dike had been overtopped and breached, which confirms that this small freeboard is a serious problem. A 1977 inspection report made by the NHWRB indicates that the dike was overtopped by approximately 1 inch near the center of the dike and by 5 to 7 inches in a ponded section beyond the east end of the dike.

Trees and brush are growing on both the upstream and downstream faces of the dike, and could pose a long-term problem when the trees die and the roots rot. Some tree stumps located on the dike are beginning to rot.

There is some trespassing, and a footpath has been worn bare on the crest of the dike. Because of the small freeboard, erosion is a particularly serious potential problem and trespassing must be controlled so as not to initiate erosion.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures were disclosed. Baxter Lake Main Dam and its overflow spillway are the controlling structures in maintaining the normal lake level throughout the year. Because of the difference in ownership between the Main Dam and the Easterly Dike, the operation and maintenance of the controlling structure is directly related to the conditions it may impose upon the other impounding barriers. There is a verbal agreement between Baxter Lake Recreation Area, Inc. and Lancelot Shore Home Owners Association in Farmington, N.H. regarding the level of Baxter Lake. The agreement simply is to maintain the level at recreational (normal) pool throughout the year. The pool level is primarily controlled by operation of the sluice gate.

4.2 Maintenance of Dike

The owner has had trees and brush cut, probably within the last 3 or 4 years. He states that he placed some fill on the upstream face during the last two years. Little other maintenance was noted. No regular maintenance procedures were disclosed.

4.3 Maintenance of Operating Facilities

Not applicable.

4.4 Description of Any Warning System in Effect

No written warning system was disclosed. However, Lonnie Pevear, (603) 332-3600, a maintenance man who works daily at Baxter Lake Recreation Area, is on call at all times. The Easterly Dike is carefully watched with regard to potential overtopping and Lonnie Pevear is contacted by Harry Baxter, owner of the Easterly Dike, when this situation is approached.

4.5 Evaluation

The present operating procedures are probably effective for normal recreational pool operations and runoff conditions. They are not adequate should the watershed experience a major storm with a large runoff.

The maintenance of the dike is poor. The owner should establis a regular maintenance procedure and a surveillance and warning system to be exercised during floods.

SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. Design Data. Design plans of the original construction of the Main Dam and two dikes dated 1921 and the reconstruction plans for the Main Dam and Center Dike along with limited hydrologic and hydraulic information were obtained from the files of the NHWRB. The above information was assessed to determine its acceptability in evaluating the overtopping potential of the structures impounding Baxter Lake.

Baxter Lake Easterly Dike is classified as being intermediate in size having a maximum storage of 1,720 acre-feet.

To determine the hazard classification for Baxter Lake Easterly Dike, the impact of failure of the dike at maximum pool was assessed using Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dike to Meaderboro Corner on State Route 202A, a distance of about 1.9 miles. Failure of Baxter Lake Easterly Dike at maximum pool would probably result in an increase in stage of 5.6 feet along the reach. An increase in water depth of this magnitude would probably result in the loss of less than 10 lives and cause severance of Ten Rod Road located about 0.4 miles downstream of the dike.

As a result of the analysis described above, Baxter Lake Easterly Dike was classified - Significant Hazard. Using OCE Recommended Guidelines for Safety Inspection of Dams, the recommended spillway test flood is the Probable Maximum Flood. The test flood discharge for Baxter Lake Easterly Dike, having a drainage area of 4 square miles, was determined to be 2850 cfs.

b. Experience Data. Because of the spillway inadequacy at the Main Dam and the fact that points of the Easterly Dike are only 1 foot above stoplog spillway elevation, previous overtoppings of the dike have occurred. The east end of the dike was breached in May 1954. A 1977 inspection report made by the NHWRB indicated the dike was overtopped again. Interviews of area residents reflect that the dike is subject to frequent overtoppings.

c. Visual Observations. The Easterly Dike is the lowest of the impounding structures on Baxter Lake. The

crest varies from 1 foot to 2 feet above the stoplog spillway. Trespassing has worn the crest bare in places and poses a potential erosion problem. The dike is also subject to heavy winds and waves which have raveled the upstream face. No evidence of damage from prior overtoppings was visible at the time of inspection.

d. Overtopping Potential. Baxter Lake Easterly Dike, along with the Center and Westerly Dikes, and the Main Dam, form the system of barriers which impound Baxter Lake. The Easterly Dike is unable to contain the test flood without overtopping. The water depth over the lowest point was calculated to be 2.1 feet.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Inspection. The visual inspection revealed three areas of stability problems:

(1) extensive seepage along the downstream toe,

(2) the limited freeboard above the present water level to the crest of the dike, and

(3) trespassing on the crest of the dike.

The trespassing on the crest of the dike could lead to serious erosion over the long term if not stopped. The limited freeboard could also contribute to erosion during periods of high wave activity. The tree roots that cross the crest of the dike could lead to piping during periods of high reservoir level after the roots have rotted.

The visual inspection did not reveal any evidence of the concrete core wall noted on the plan labeled "Dam Number Three" as drawn by L. E. Scruton, C. E. (See Appendix B.)

A March 1977 inspection report at the NHWRB noted a longitudinal crack in the surface of the dike extending nearly the full length of the dike. No evidence of this crack was visible at the time of the June 1978 inspection.

b. Design and Construction Data. An available design drawing, labeled "Dam Number Three", indicates the presence of a concrete core wall along the center of the dike. However, no information is available about the as-constructed dimensions or conditions within the dike, the foundation or the character of the earthfill used in constructing the dike.

c. Operating Records. No operating records pertinent to the structural stability of the dike were disclosed.

d. Post-Construction Changes. A field inspection report dated November 17, 1954 indicated that "...in 'May 1954', the easterly end of the east dike washed out but was temporarily repaired...".

Mr. Baxter, owner of the dike, states that approximately 6 inches of additional material was placed on the dike in 1941

along with the stone face above the waterline. Mr. Baxter also reported that some additional fill had been placed upstream within the last two years.

e. Seismic Stability. This dike is in Seismic Zone 2 and hence does not have to be evaluated for seismic stability according to OCE Recommended Guidelines.

SECTION 7
ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dike Assessment

a. Condition. The visual inspection indicates that the Easterly Dike on Baxter Lake is in poor condition.

The major concerns with regard to the long-term integrity of the dike are:

(1) extensive seepage at the downstream toe of the dike;

(2) very small freeboard at the east end, combined with inadequate spillway capacity at the Main Dam on Baxter Lake and the historical record that the dike has been overtopped, breached, and rebuilt;

(3) trees and brush growing on the upstream and downstream slopes of the dike.

b. Adequacy of Information. The information available is such that the assessment of the dike must be based primarily on the visual inspection. The historical record of overtopping and breaching of the Easterly Dike confirms the validity of the visual observation that the freeboard is too small.

c. Urgency. The remedial measures recommended in 7.2 below should be carried out within one year.

d. Need for Additional Information. The information obtained and visual inspection are deemed adequate for purposes of this evaluation.

7.2 Recommendations

The owner should engage the services of a registered professional engineer to:

a. Evaluate the necessary freeboard requirements of the Easterly Dike based on the hydrology of the Baxter Lake drainage area and the capacity of the spillway and gated outlet at the Main Dam (which is under the control of a different owner).

b. Design the remedial measures for eliminating and/or controlling the seepage at the downstream toe of the dike.

7.3 *Remedial Measures*

a. Alternatives. Lowering of the lake until recommended corrective measures are completed is a viable alternative.

b. Operation and Maintenance Procedures.

(1) The trees and brush should not be cleared from the dike until the recommended measures for increasing the freeboard and controlling the seepage at the downstream toe of the dike are implemented. The reason for this is that the roots of the trees and brush will provide some resistance against erosion if the dike should be overtopped again.

(2) After the freeboard is increased and the downstream seepage problem is remedied, the upstream slope, downstream slope, and an area 25 feet downstream of the dike should be maintained free of trees and brush.

(3) The roots should be removed from the dike and backfill placed under the supervision of a professional engineer.

(4) The seepage downstream of the dike should be monitored on a weekly basis.

(5) A surveillance and warning program to be exercised during floods should be established in cooperation and coordination with the owner of the Main Dam.

APPENDIX A

CHECK LIST - VISUAL INSPECTION

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

ROJECT Baxter Lake, New Hampshire
Easterly Dike

DATE June 14, 1978

TIME 4:00 P.M.

WEATHER Cool, windy, partly cloudy

W.S. ELEV. 412.7 U.S. 406.2 DN.S.

ARTY:

1. Warren Guinan
2. Stephen Gilman
3. Leslie Williams
4. Ronald Hirschfeld
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	W. Guinan/L. Williams	
2.	Structural Stability	S. Gilman	
3.	Soils and Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Baxter Lake, New Hampshire Easterly Dike — DATE June 14, 1978

PROJECT FEATURE Dike Embankment — NAME

DISCIPLINE Structural & Soils/Geology — NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	414
Current Pool Elevation	412.7
Maximum Impoundment to Date	Unknown
Surface Cracks	None
Pavement Condition	Not paved
Movement or Settlement of Crest	Little settlement of earth
Lateral Movement	None
Vertical Alignment	Good. Owner claims that about 6 inches add'l material placed on dike in 1941 along with placemen of stone face above water line.
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good at abutment, core wall not visible.
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Pathway on crest of dike
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Extensive seepage at downstream t especially at east end of dike.
Piping or Boils	Owner claims seepage like this f many years.
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

PROJECT Baxter Lake Easterly Dike DATE June 14, 1978

PROJECT FEATURE Reservoir NAME L. Williams

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	No visible problems
Changes in Watershed Runoff Potential	Minor
Upstream Hazards	Few homes; lowest is 4' above lake.
Downstream Hazards	Ten Rod Road and Meaderboro Corner on State Route 202A
Alert Facilities	None observed
Hydrometeorological Gages	None
Operational & Maintenance Regulations	None observed

APPENDIX B

INSPECTION REPORTS/SKETCHES

BAXTER EASTERLY DIKE

March 21, 1977

Donald M. Rapoza

Baxter Lake Dam Nos. 204.09, 204.10, & 204.11

At 6:15 a.m. on March 14, 1977 I received a call from Mrs. Baxter informing me that water was going over the dike and a section of their property and their basement was flooded.

I contacted William Rickey, the owner of the property & Rickey Company, and requested that he make provisions to inspect the property and take the necessary measures to alleviate the flooding conditions. I met Mr. James Nass, project engineer for the Rickey Company and together we viewed the dikes, spillway, and dam and found the following:

Dam (#204.11)

Water was 10 inches over the upstream concrete wall and 2 feet below the top of dam. The platform for the gate lifting mechanism was submerged.

Spillway

Water was 11" above the concrete abutments. Steel beam was not removed and restricting the discharge from the pond.

Dike (#204.10)

No visible problem with the dike. Approximately 5 feet freeboard.

Dike (#204.09)

Found the dike was being topped (approximately 1 inch) at midpoint between the abutments and at Mr. Baxter's property, section 27 feet long and 57" max. depth. I also found a longitudinal surfact crack almost the entire length of the dikes.

Mr. Nass and I also viewed the two major roads downstream of the structure for additional discharge capacity from Baxter Lake and it was decided after some discussion that the owners were going to lower the lake probably though the gate section and monitor the roadway immediately downstream of the structure to minimize any roadway flooding.

I made mention that the owner was liable for damages caused by his management of lake levels or discharges and strongly suggested that he remove the steel beam located between the concrete abutments in the spillway as the beam was restricting flow from the lake and causing problems with private property and the dike.

While at Mr. Baxter's property I placed two nails into two pines to establish a high water mark and requested that Mr. Baxter measure the water level the following day. I called Mr. Baxter on March 15, 1977 and he reported that the lake had receded approximately 5 inches.

M E M O

From: Donald Rapoza, Civil Engineer — October 29, 1976

To: Vernon Knowlton, Chief Engineer

SUBJECT: INSPECTION OF DAM AND DIKES AT OUTLET OF BAXTER LAKE IN ROCHESTER

DAM # 204.09 - #204.10 - #204.11

As requested I inspected the dam and dikes on September 17, 1976, at the outlet of Baxter Lake in Portsmouth, N.H.

The dam is presently owned by Richie Builder Associates of Barnstead, N.H. Mr. Richie and Mr. James Fitzpatrick met me at the site and we reviewed the dam and dike and I pointed out some of the following maintenance items which needed their attention:

Dam #204.11 (Main Structure and Spillway)

1. Gate Lifting Mechanism - Someone has removed parts of the gate lifting mechanism making the gate inoperable. Calculations in our files indicate that flow through the gate is required to pass the 100-year storm.

2. Some concrete is spalling on the upstream facing of the dam.

3. There is a small amount of seepage on the downstream side of dam adjacent to the principal spillway pipe which should be monitored.

4. Expansion joints should be repaired and filled with joint filler.

Spillway - The flashboards and pins were removed and a 10 x 27 I Beam was placed between the spillway abutments.

Dam #204.10 (Center Dike)

1. Trees and other woody growth should be removed from the upstream and downstream faces of the dam.

2. There is seepage located at the left abutment on the downstream side of the structure. It is not critical at this time but the owner should be made aware of the potential problem and the area monitored by the owner and the results reported to our office yearly or when any appreciable increases are found at the site.

Dam #204.09 (Lower Dike adjacent to Baxter Property)

1. Trees and all woody growth should be removed from the top and both sides of the structure.

2. Seepage along the toe of the structure should be monitored.

3. Damaged dike areas should be repaired. Mr. Baxter reported that he repaired the dike sometime ago when the dike was breached.

OPERATIONS RECOMMENDATIONS:

The lake should be drawn down to the permanent crest of the spillway section after the recreation season and the boards replaced after spring runoff.

D:R:L

11/17/54

Field Inspection of Leader Reservoir, Rochester

On Wednesday afternoon, November 10, I inspected the dam and dikes at Leader Reservoir owned by the Sonic Manufacturing Company of Sonic. After inspection I discussed this matter with the Assistant Superintendent of the Company. The following is the results of this trip:

BASIC DATA

276 (1959)

Pond Area: ~~239~~ acres
Drainage Area: 4.1 sq.mi. or 2624 acres (Total)
25-Year Flood Discharge: 382 cfs.
100-Year Flood Discharge: 695 cfs. or 170 cfs/sq.mi.
1 Inch of runoff from D... (less pond area) raises pond 10 inches.

In May 1952, the easterly end of the east dike washed out but was temporarily repaired with help from the City of Rochester Board of Public Works personnel. This dike was and is low and the high water conditions plus heavy wind toward the dike caused the failure. The east dike is only 1.6 feet above full pond or 2.6' above the spillway crest. The dry masonry facing (pond side) is raveling. Some overtopping at flood time has eroded the top of dike. One 5" poplar has been uprooted near the west end of dike causing a weak point. Downstream slope is 1 on 1 which is very steep.

The center dike is 6.8 ± feet higher than spillway sill (5.2'± above full pond). This dike is in good condition and requires no work done on it.

The main dam is 4.3 ± feet higher than the spillway sill (3.3'± above full pond). This dam is in good condition and requires no work done on it.

The spillway is nearly plugged with driftwood and debris. The entrance channel is blocked with a floating island of brush which decreases capacity of channel. The 12" flashboard is held by 6 - 1½" std pipe pins which would fail with 21 feet of surcharge - this is excessive. There should be four 1/2" std pipe pins across the 16 foot spillway to fail with 17½ inches surcharge while discharging 105 cfs or 25 cfs/sq.mi. (neglecting discharge through 36" corrugated metal pipe outlet.)

The following recommendations are presented for consideration:

PLAN I: Remove debris from the spillway channel, flashboard section, inlet and outlet channel including towing of the floating island into a protected cove and anchoring it. Permanent removal of the flashboards and flashboard pins. Lowering of the pond level to the level of the spillway crest except at times of high water. During high water open the gate, as necessary, to full open.

PLAN II: (a) Replace flashboard pins with a total of 4 standard ¾" pipe pins spaced 5 feet apart holding 2" plank 13' long and 12" wide. (b) Remove floating island to a location from which it won't again block the spillway inlet channel. (c) Clean out both inlet and outlet channels and flashboard location of all debris, driftwood and tree growth. (d) Raise the east dike by 2 feet, flattening the downstream slope to 1 foot vertical on 2 foot horizontal, including prior clearing slopes of all vegetation before placing fill, and, (e) Riprap protection to flattened pond side slope of this dike. Improvement in operation can be obtained by removing the flashboards in the late fall and replacing them after the spring freshet has passed.

The capacity of the spillway at 4 feet deep would be about 360 cubic feet per second. This is only about 2 15-year flood flow. With the gate full open, it would pass about 490 cfs. The capacity at present with flashboards out and gate wide open is about 340 cfs.

It should be noted that the new 1/2" flashboard pins should be located within 6 inches of the downstream edge of the spillway concrete so that failure at high water would be positive. They should be set in pipe sockets, too.

I recommend that the Conic Manufacturing Company be requested immediately to:

(a) Remove flashboards until the east dike is raised.

(b) Clear out all types of debris from inlet and discharge channels of spillway.

(c) Remove the floating island from the inlet channel.

Francis C. Moore
Civil Engineer

fcm:c
11/17/54

204.09 Easterly Dike

NEW HAMPSHIRE WATER CONTROL COMMISSION

REPORT ON DAM INSPECTION

TOWN Rochester DAM NO 204.09 STREAM Richars Brook

OWNER Gonic Mfg. Co. ADDRESS Gonic, N.H.

In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on July 23, 1950 ~~accompanied by~~

NOTES ON PHYSICAL CONDITION

Abutments Good

Spillway None (a dike)

Gates None (a dike)

Embankment; Other Fair - Some erosion where traffic was heavy (Good - Some erosion where traffic was heavy)

CHANGES SINCE LAST INSPECTION Rebuilt in 1941-1942

FUTURE INSPECTIONS Yes

This dam (is) (~~is not~~) a menace because of people and property downstream

REMARKS

Copy to Owner	Date

Francis C. Moore
INSPECTOR

(Additional Notes Over)

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 204.09

Town Rochester : County Strafford

Stream Leader Pond (east Dike)

Basin-Primary ~~Cocheco~~ Cocheco : Secondary ~~Cocheco~~ Rte 2 Bridge

Local Name East Dike

Coordinates—Lat. 43° 20' + 4800 : Long. 71° 01' + 5000

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total ~~1.6~~ 3.8 Sq. Mi.

Overall length of dam 340' ft.: Date of Construction Repaired 1935

Height: Stream bed to highest elev. 12' ft.: Max. Structure 8'6" ft.

Cost—Dam : Reservoir

DESCRIPTION Gravity earth rock and concrete

Waste Gates Foundation ~~ledge~~ earth

Type

Number : Size ft. high x ft. wide

Elevation Invert : Total Area sq. ft.

Hoist

Waste Gates Conduit

Number : Materials

Size ft.: Length ft.: Area sq. ft.

Embankment (Earth with concrete core & upstream dry masonry wall)

Type Earth with concrete core and upstream dry masonry wall

Height—Max. 10' ft.: Min. ft.

Top—Width 12'6" : Elev. ft.

Slopes—Upstream Vertical on : Downstream 1 on 1½:1

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction Spills over main dam

Length—Total 100' ft.: Net ft.

Height of permanent section—Max. ft.: Min. ft.

Flashboards—Type : Height ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. ft.: Min. ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Conic Mfg. Co.

REMARKS Condition fair Subject to inspection

Use conservation - Inspected 12-12-52 Inspected May 19 1952

Tabulation By G.S.M. Date

H&B 21254

WATER CONTROL COMMISSION

MEMORANDUM - September 9, 1941

Case No. C187-C

TO: Richard S. Holmgren, Chief Engineer

RE: Meader Pond in Rochester

On Monday, September 8, 1941, I visited Ricker Pond dam (also called Meader Pond) in Rochester. It is located on Ricker Brook about 4 miles from Rochester and about one-fourth of a mile from the intersection of Ricker Brook with Two Rod Road, so-called. Mr. Hart of the Gonic Manufacturing Company was present.

The dam was constructed in 1922 by the Gonic Manufacturing Company for storage purposes. It consists of a concrete section across the outlet of the pond about 160 feet in length and 15 feet maximum height. The spillway located at the center of the dam is 18 feet long with a 15-inch freeboard. Water is released through a 36-inch cast iron pipe running through the base of the dam. The concrete section is spalling badly on both the upstream and downstream sides and a crack has opened up at the center.

The Company proposes to reconstruct this dam and one of the dikes. They propose to face the upstream side of the concrete section with an 8-inch thickness of waterproof concrete and fill the downstream side with an impervious fill. The top of this new section will be at elevation 99.5 (local base.) A channel spillway

- Spillway.
- freeboard
- Slope on embankment.

will be excavated around the east end of the dam with a bottom width of 16 feet at elevation 98.0. This gives a freeboard of 1.5 feet which was the freeboard of the old structure. The dike will have a top width of 10 feet with side slopes of 2 on 1 with the upstream face riprapped. The top will be at elevation 105.0.

The drainage area at the dam is 3.8 square miles. If the new spillway were constructed with a five-foot freeboard by raising the new section to elevation 103.0 it could discharge 168 cfs per square mile.

The Company plans to begin construction as soon as approval is given.

Respectfully submitted,

John H. Spellman

John H. Spellman
Assistant Engineer

JHS:GMB

PUBLIC SERVICE COMMISSION OF NEW HAMPSHIRE—DAM RECORD I-4921

TOWN	Rochester	TOWN NO. 9	STATE NO. 204.1
RIVER STREAM	Meader Pond (East Dike)		
DRAINAGE AREA	1.6 Sq. Mi.	POND AREA	
DAM TYPE	Gravity	FOUNDATION NATURE OF	Earth
MATERIALS OF CONSTRUCTION	Earth, Rock, Concrete		
PURPOSE OF DAM	POWER—CONSERVATION—DOMESTIC—RECREATION—TRANSPORTATION—PUBLIC UTILITY		
HEIGHTS, TOP OF DAM TO BED OF STREAM	10'	TOP OF DAM TO SPILLWAY CRESTS	16"
SPILLWAYS, LENGTHS DEPTHS BELOW TOP OF DAM		LENGTH OF DAM	340'
FLASHBOARDS TYPE, HEIGHT ABOVE CREST			
OPERATING HEAD CREST TO N. T. W.		TOP OF FLASHBOARDS TO N. T. W.	
WHEELS, NUMBER KINDS & H. P.			
GENERATORS, NUMBER KINDS & K. W.			
H. P. 90 P. C. TIME 100 P. C. EFF.		H. P. 75 P.C. TIME 100 P. C. EFF.	
REFERENCES, CASES, PLANS, INSPECTIONS			
REMARKS			

OWNER- Gonic Mfg. Co.

CONDITION- Fair

MENACE- Yes. Will be subject to periodic inspection.

Recommended 1941-35

To the Public Service Commission:

The foregoing memorandum on the above dam is submitted covering inspection made November 19, 1935, according to notification to owner dated November 16, 1935 and bill for same is enclosed.

Nov. 30, 1935
Copy to Owner

Samuel J. Lord
Hyd. Eng.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Ocean NO. 9 — 57 — E-4921
RIVER Meader Pond MILES FROM MOUTH D.A.SQ.MI. 1.6
TOWN Rochester OWNER Sonic Mfg. Co. Sonic
LOCAL NAME OF DAM East Dike
BUILT DESCRIPTION Gravity — Earth, Rock, Concrete. ON Earth

POND AREA-ACRES DRAWDOWN FT. POND CAPACITY-ACRE FT.
HEIGHT-TOP TO BED OF STREAM-FT. 10 MAX. MIN.
OVERALL LENGTH OF DAM-FT. 340 MAX.FLOOD HEIGHT ABOVE CREST-FT.
PERMANENT CREST ELEV.U.S.G.S. LOCAL GAGE
TAILWATER ELEV.U.S.G.S. LOCAL GAGE
SPILLWAY LENGTHS-FT. none FREEBOARD-FT.
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST
WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST

REMARKS Condition Fair Spills over main dam.
(Condition Fair) (Spills over main dam)
Rickers Bk. Cocheco R.
(Rickers Bk, Cocheco R.)

POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE

USE Conservation (Conservation)

REMARKS Acreage

DATE 11/19/35

Co.

No.

CALCULATION SHEET

Date 11-

Refers to

Made By

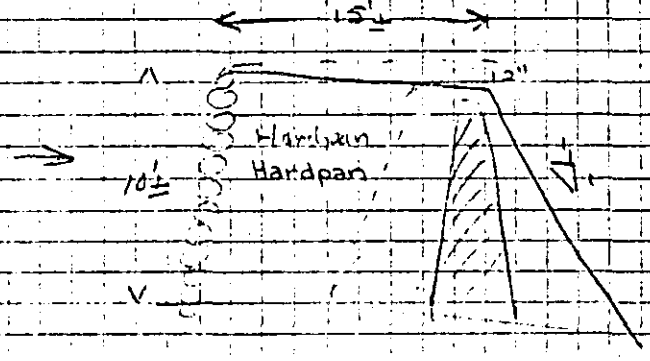
3648

FAST DIKE

I-4921

Repaired 1935

MEADERS POND



PUBLIC SERVICE COMMISSION
OF
NEW HAMPSHIRE

CONCORD May 31, 1922.

Hon. John W. Storrs, Commissioner,
Public Service Commission,
Concord, New Hampshire.

Dear Sir:-

In re: The Gonic Manufacturing Company dam at Rochester, New Hampshire.

On Thursday, May 25, 1922, I made an inspection of the site of the development being carried on for the Gonic Manufacturing Company.

The foundation for dams Nos. 2 and 3 had been mostly uncovered, and although practically no ledge was encountered in the trench for the cut-off wall, I believe the intended foundation is impervious and thoroughly substantial to put the proposed concrete cut-off on. I advised Mr. Scruton, the engineer, that he could proceed with the work on dams Nos. 2 and 3 according to the plans filed with the Public Service Commission.

In conference with Mr. Scruton regarding the spillway capacity of dam No. 1 it was decided that it would be well to augment the proposed spillway capacity by putting in an auxiliary 20-foot overflow to be made at a location near dam No. 1. The top elevation of this overflow would be not more than 6 inches above the

top of the main spillway, resulting in the availability of two spillways when water was impounded 6 inches over the primary spillway. The foundation of dam No. 1 was not uncovered, but we will be advised when such is ready for inspection.

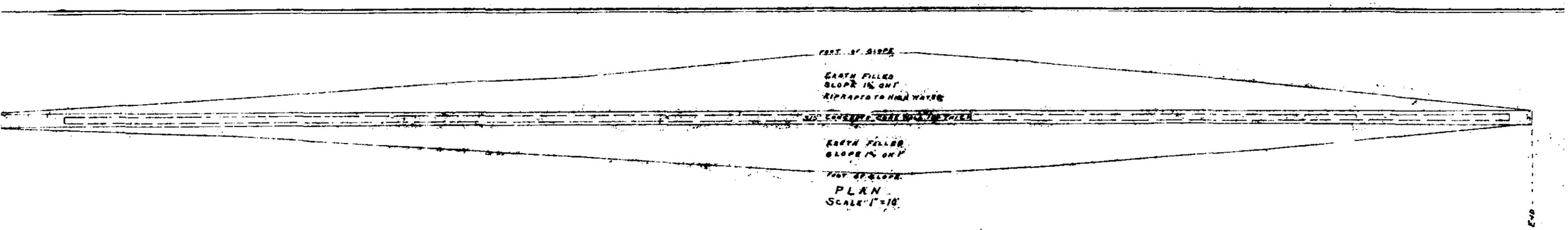
The gravel to be used in the concrete mix is the natural run of the bank and appears to be of a specially good quality. Mr. Scruton is personally in charge of all construction and is living at the site. The cement to be used has been stored at the dam, and sample concrete blocks have been made to determine the best mix from the available gravel.

A later inspection of the foundation of dam No. 1 will be made and a report submitted.

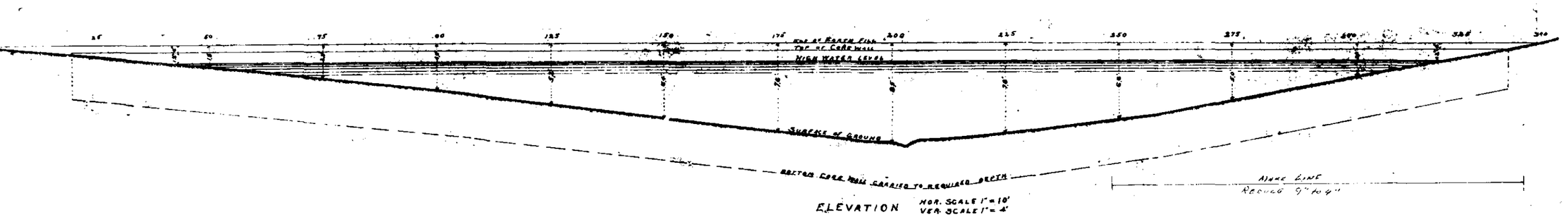
Very truly yours,

B. H. Moxon.

BHM:HWW Inspector.



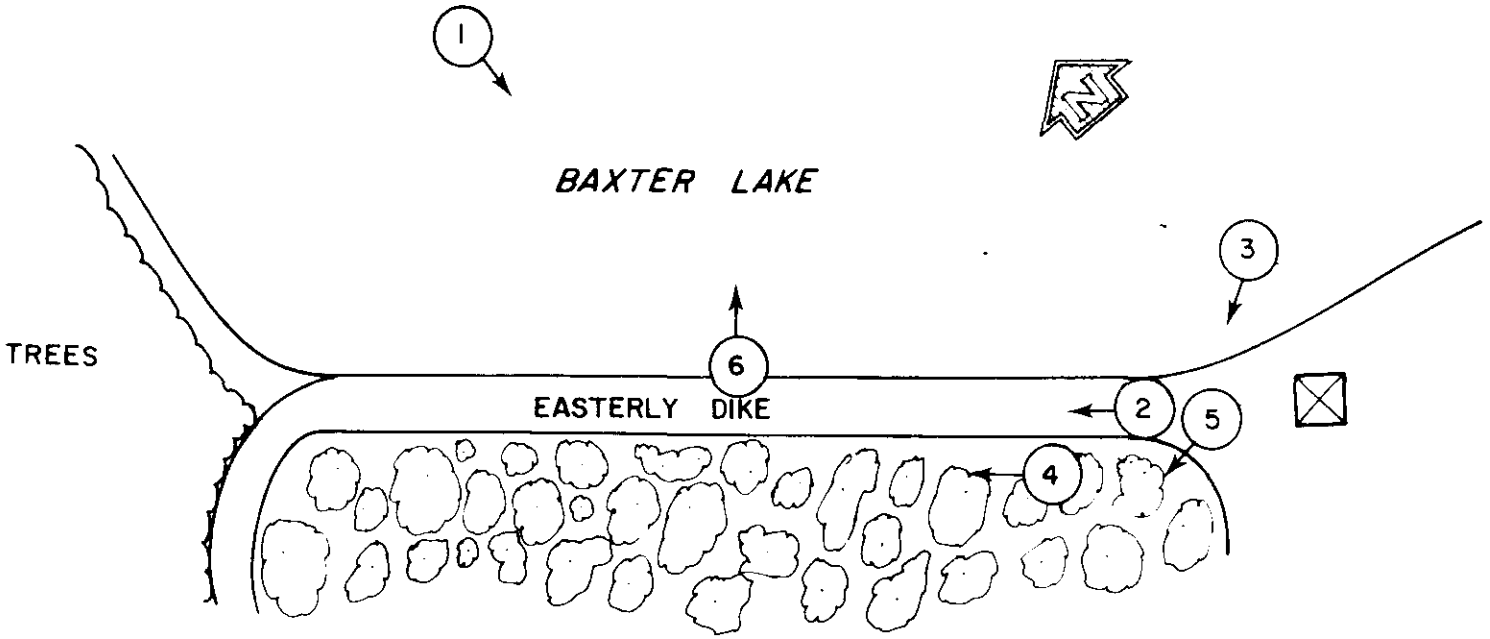
DAM NUMBER THREE



L. E. SCRUTON, C.E.

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BAXTER LAKE EASTERLY DIKE PHOTO INDEX

BAXTER LAKE NEW HAMPSHIRE

			SCALE: NOT TO SCALE
			DATE: AUGUST 1978

Figure 2 - Looking northwest across the top of the dike.

Figure 3 - Looking at the upstream face and south-east abutment. The low point beyond the abutment is at the center of the photo. Note wave action.

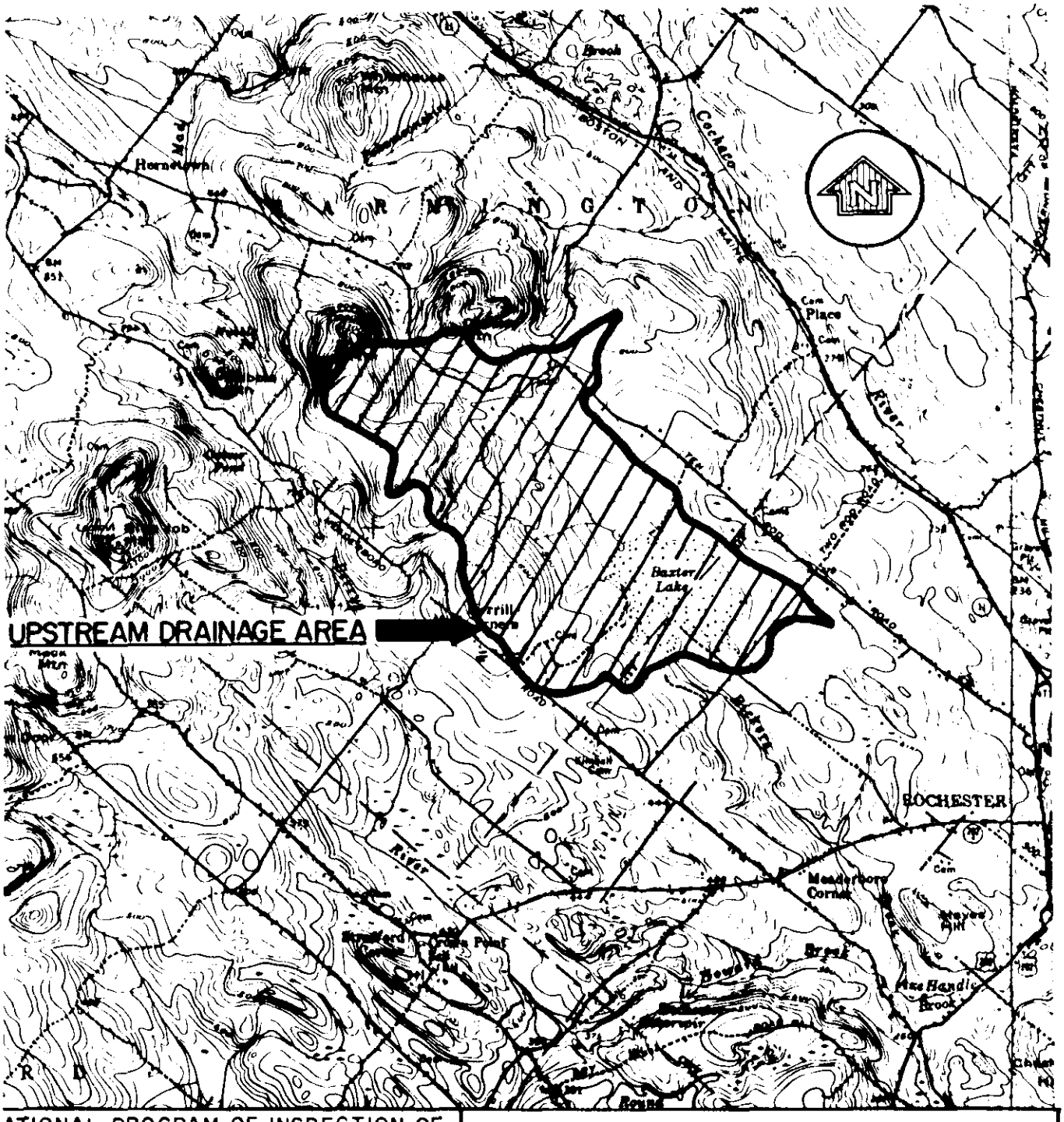
Figure 4 - Looking northwest across the downstream face of the dike.

Figure 5 - Seepage at downstream toe of dike near southeast end.

Figure 6 - Looking upstream at the reservoir from the center of the dike.

APPENDIX D

HYDROLOGY/HYDRAULICS



ATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BAXTER LAKE EASTERLY DIKE

ROCHESTER, NEW HAMPSHIRE

REGIONAL VICINITY MAP

JULY 1978

DEPARTMENT OF THE ARMY
IEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ERSON-NICHOLS & CO., INC. CONCORD, NH

SCALE IN MILES

1 ½ 0 1 2

MAP BASED ON U.S.G.S. 15 MINUTE QUADRANGLE SHEET ALTON, N.H. 1957.

DA = 3.98 mi.²
Size Classification = Intermediate
Hazard Classification = Significant
Inspection Flood = ½ PMF to PMF

Step #1
Calculate PMF using "Preliminary Guidance For Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, March 1978."

Use Flat & Coastal

@ 3.98 mi.² P.M.F. in cfs/mi.² = 840

P.M.F. Baxter Lake is:

840 cfs/mi.² × 3.98 mi.² = 3343 cfs

Peak Inflow = 3345 cfs

Assumptions:
36" gate @ base of dam closed
Overflow spillway flashboards in - assuming they will not fail at PMF

C Values

Overflow Spillway (sharp crested weir)	4.0
Easterly Dike	2.8
Westerly Dike	2.8
Center Dike	2.7
Main Dam	2.7

SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Step #2a:
Determine Surcharge Height to Pass "Qp1" of 3345 cfs.

TRIAL #1
Assume Elevation of 415.0

$Q_{OVERFLOW\ SPILLWAY} = CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\frac{1}{2}8)(1.75)^{3/2} + 4.0(\frac{1}{2}7)(1.75)^{3/2} + 4.0(22)(1.75)^{3/2}$
$= 9 + 37 + 32 + 204$
$= 282$ cfs

$Q_{EASTERLY\ DIKE} = CLH^{3/2}$
$Q = 2.8(\frac{1}{2}21)(1)^{3/2} + 2.8(\frac{1}{2}25)(1)^{3/2} + 2.8(\frac{1}{2}100)(1)^{3/2} + 2.8(\frac{1}{2}50)(0.5)^{3/2} + 2.8(50)(0.5)^{3/2} + 2.8(100)(0.5)^{3/2} + 2.8(\frac{1}{2}100)(0.3)^{3/2} + 2.8(\frac{1}{2}20)(0.8)^{3/2}$
$= 29 + 35 + 140 + 25 + 50 + 99 + 23 + 20$
$= 421$ cfs

$Q_{TOT} = 282 + 421$
$= 703$ cfs

TRIAL #2
Assume Elevation of 416.0

$Q_{OVERFLOW\ SPILLWAY} = CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\frac{1}{2}12)(2.75)^{3/2} + 4.0(\frac{1}{2}11)(2.75)^{3/2} + 4.0(22)(2.75)^{3/2}$

$= 9 + 109 + 100 + 401$
$= 619$ cfs

$Q_{EASTERLY\ DIKE} = CLH^{3/2}$

$Q = 2.8(\frac{1}{2}43)(2.0)^{3/2} + 2.8(\frac{1}{2}25)(1)^{3/2} + 2.8(\frac{1}{2}100)(1)^{3/2} +$
$2.8(125)(1.0)^{3/2} + 2.8(150)(1.5)^{3/2} + 2.8(\frac{1}{2}50)(0.5)^{3/2}$
$2.8(\frac{1}{2}100)(0.3)^{3/2} + 2.8(\frac{1}{2}50)(1.8)^{3/2}$

$= 170 + 35 + 140 + 350 + 772 + 25 + 23 + 169$
$= 1684$ cfs

$Q_{WESTERLY\ EMBANKMENT} = CLH^{3/2}$

$Q = 2.8(\frac{1}{2}4)(0.5)^{3/2} + 2.8(\frac{1}{2}4)(0.5)^{3/2} +$
$2.8(200)(0.5)^{3/2}$

$= 2 + 2 + 198$
$= 202$

$Q_{TOT} = 619 + 1684 + 202$
$= 2505$ cfs

@ Elev. of 116.0
Contained by center dike
Contained by main dam embankment

TRIAL #3

Assume Elev. @ 416.3

Q overflow spillway = $CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\frac{1}{2}13.5)(3.05)^{3/2} + 4.0(\frac{1}{2}12)(3.05)^{3/2} + 4.0(22)(3.05)^{3/2}$

$= 9 + 144 + 128 + 469$

$= 750$ cfs

Q easterly dike = $CLH^{3/2}$

$Q = 2.8(\frac{1}{2}50)(2.3)^{3/2} + 2.8(125)(1.3)^{3/2} + 2.8(150)(1.8)^{3/2} + 2.8(\frac{1}{2}25)(1.0)^{3/2} + 2.8(\frac{1}{2}100)(1.0)^{3/2} + 2.8(\frac{1}{2}50)(0.5)^{3/2} + 2.8(\frac{1}{2}100)(0.3)^{3/2} + 2.8(\frac{1}{2}56)(2.1)^{3/2}$

$= 249 + 519 + 1014 + 35 + 140 + 25 + 23 + 239$

$= 2239$ cfs

Q westerly embankment = $CLH^{3/2}$

$Q = 2.8(\frac{1}{2}18)(0.8)^{3/2} + 2.8(\frac{1}{2}20)(0.8)^{3/2} + 2.8(200)(0.8)^{3/2}$

$= 18 + 20 + 401$

$= 439$ cfs

416.3 @ top of main dam embankment
416.3 contained by center dike

$Q_{TOT} = 3428$ cfs

Surcharge Height to Pass PMF is 3.3' above overflow spillway (416.3 - 413.0 = 3.3') and 4.3' above permanent overflow spillway crest.

ARES N. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Step 2. b.

Determine Volume of Surcharge in Inches of Runoff.

Normal Ac-Ft. Storage = 1400
Surface Area = 316 acres = 13764960 ft²
Normal Pool @ Elevation 413.

Frustrum of Pyramid

$V = \frac{1}{3} h (b_1 + b_2 + \sqrt{b_1 b_2})$

h = elev. above normal pool
b_2 = enlarged surface area in ft²
b_1 = normal pool surface area in ft²

@ Elev. 420

Surface area = 461 acres = 20081160 ft²

$V = \frac{1}{3} 7 (13764960 + 20081160 + \sqrt{13764960 \times 20081160}$
$= \frac{1}{3} 7 (33846120 + 16625774)$
$= \frac{1}{3} 7 (50471894)$
$= 11.77617527 \times 10^7 \text{ ft}^3 \times \frac{1 \text{ acre}}{43560 \text{ ft}^2} = 2705 \text{ ac-ft}$

Surcharge Height to PASS PMF is 3.3'

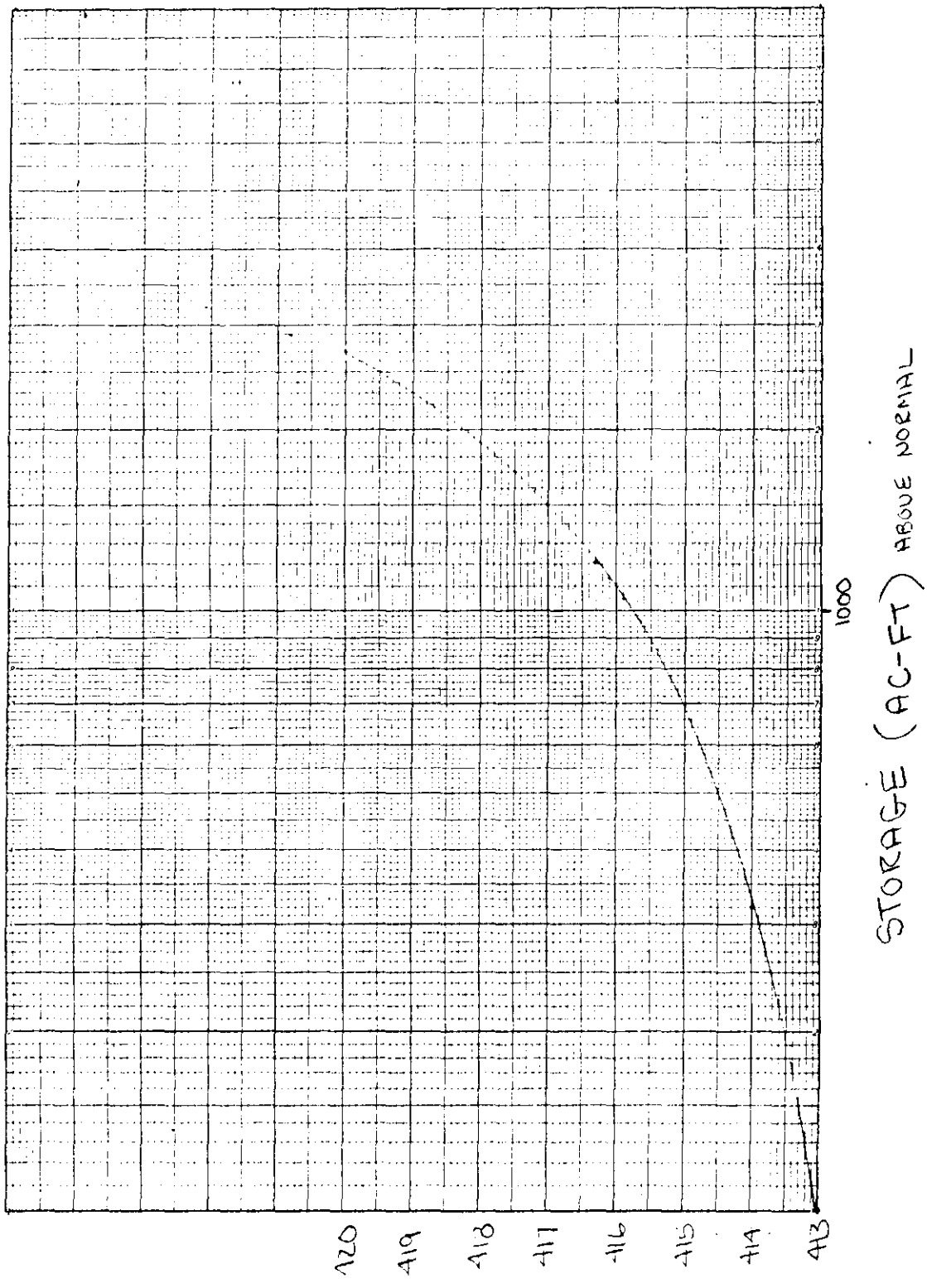
Volume = 5.3×10^7 ft³
Spillway Volume = 0 ft³

$5.3 \times 10^7 \text{ ft}^3 \times \frac{1}{3.98 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{(5280)^2 \text{ ft}^2} = 0.48 \text{ ft.}$

$0.5 \text{ ft.} \times 12 \text{ in/ft} = 5.73 \text{ inches runoff}$

2c

$Q_{p2} = Q_{p1} \times (1 - \frac{\text{Stor}}{19''})$
$Q_{p2} = 3345 \text{ cfs} (1 - \frac{5.73''}{19''})$
$Q_{p2} = 3345 \text{ cfs} \times 0.70$
$Q_{p2} = 2289 \approx 2340 \text{ cfs}$


STORAGE (AC-FT) ABOVE NORMAL
1000
420
419
418
417
416
415
414
413

SQUARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Step 3a.

Determine Surcharge Height a "STOR2" to Pass "Q_{P2}" of 2340 cfs.

Trial #1

Assume elevation of 415.7

$Q_{overflow\ spillway} = CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\frac{1}{2}11)(2.45)^{3/2} + 4.0(\frac{1}{2}9.6)(2.45)^{3/2} + 4.0(22)(2.45)^{3/2}$

$= 9 + 84 + 74 + 337$

$= 504$ cfs

$Q_{easterly\ dike} = CLH^{3/2}$

$Q = 2.8(\frac{1}{2}35)(1.7)^{3/2} + 2.8(\frac{1}{2}25)(1.0)^{3/2} + 2.8(\frac{1}{2}100)(1.0)^{3/2} + 2.8(125)(0.7)^{3/2} + 2.8(150)(1.2)^{3/2} + 2.8(\frac{1}{2}50)(0.5)^{3/2} + 2.8(\frac{1}{2}100)(0.3)^{3/2} + 2.8(\frac{1}{2}40)(1.5)^{3/2}$

$= 109 + 35 + 140 + 205 + 552 + 25 + 23 + 103$

$= 1192$

$Q_{westerly\ dike} = CLH^{3/2}$

$Q = 2.8(200)(0.2)^{3/2}$

$= 50$ cfs

$Q_{TOT} = 504 + 1192 + 50$

$= 1746$ cfs

@ Elev. 415.7 $Q_{TOT} = 1746$ cfs

Contained by center dike & main dam

Trial #2

Assume Elevation of 415.9

$Q_{overflow\ spillway} = CLH^{3/2}$

$Q = 4.0(18)(0.25)^{3/2} + 4.0(\frac{1}{2}12)(2.65)^{3/2} + 4.0(\frac{1}{2}10.5)(2.65)^{3/2} + 4.0(22)(2.65)^{3/2}$

$= 9 + 104 + 91 + 380$

$= 584$ cfs

$Q_{easterly\ dike} = CLH^{3/2}$

$Q = 2.8(\frac{1}{2}43)(1.9)^{3/2} + 2.8(\frac{1}{2}25)(1.0)^{3/2} + 2.8(125)(0.9)^{3/2} + 2.8(\frac{1}{2}100)(1.0)^{3/2} + 2.8(150)(1.4)^{3/2} + 2.8(\frac{1}{2}50)(0.5)^{3/2} + 2.8(\frac{1}{2}100)(0.3)^{3/2} + 2.8(\frac{1}{2}50)(1.7)^{3/2}$

$= 157 + 35 + 299 + 140 + 696 + 25 + 23 + 155$

$= 1530$ cfs

$Q_{westerly\ dike} = CLH^{3/2}$

$Q = 2.8(\frac{1}{2}4)(0.4)^{3/2} + 2.8(\frac{1}{2}4)(0.4)^{3/2} + 2.8(200)(0.4)^{3/2}$

$= 1.4 + 1.4 + 142$

$= 145$ cfs

$Q_{TOT} = 584 + 1530 + 145$ cfs

$= 2259$ cfs

At elevation 415.9 (2.9' above spillway boards; 3.9' above permanent spillway concrete) is discharge is 2259 cfs. Center dike & main dam embankment contains.

Refer to Storage Elevation Curve:

@ 415.9 Surcharge Height to Pass Qpz of 2340 cfs:

Volume = 4.6×10^7 ft^3

4.6×10^7 ft^3 $\times \frac{1}{3.98 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{(5280)^2 \text{ ft}^2} = 0.41$ ft.

0.41 ft. $\times$ 12 in/ft. = 5.0" $STOR_2$ in inches runoff

Step 3b.

STOR 1 = 5.73" runoff
STOR 2 = 5.0" runoff

Average = 5.37" runoff or 0.45'

$0.45' \times \frac{3.98 \text{ mi}^2}{1} \times \frac{(5280)^2 \text{ ft}^2}{1 \text{ mi}^2} = 5.0 \times 10^7$ ft^3

Refer to Storage Elevation Curve:

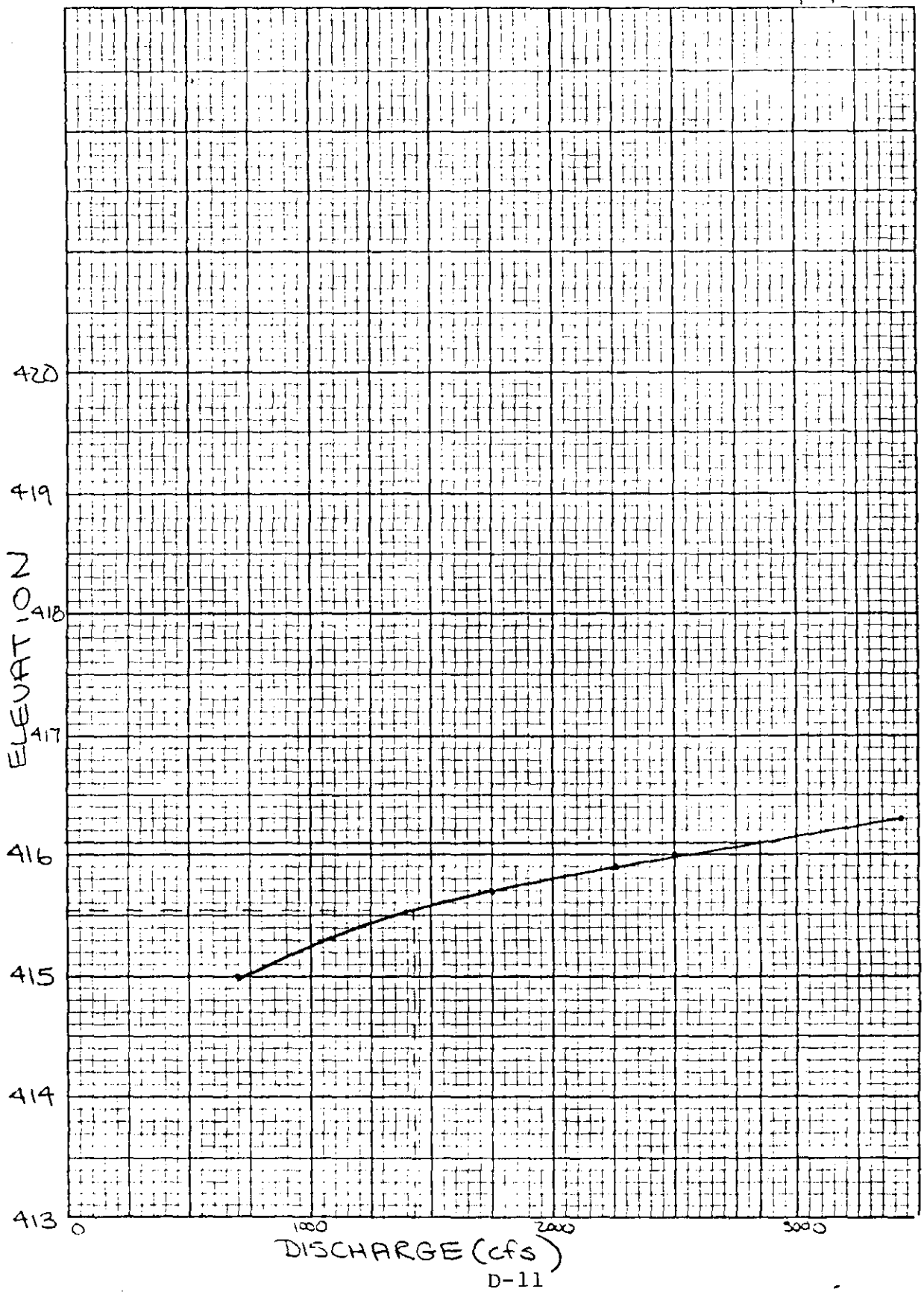
5.0×10^7 ft^3 Heads ELEVATION = 416.1

Refer to Elevation vs Discharge Curves

Elevation 416.1 = 2850 cfs

Elevation Top Boards 413.0
Elevation Spillway Concrete 412.0
Elevation low pt. easterly dike 414.0
Elevation low pt. westerly dike 415.5
Elevation low pt. center dike 417.2
Elevation top dam embankment 416.3

10/18
7/13/10 LJW



CONCLUSIONS:

PMF Discharge = 2850 cfs
Elevation 416.1

PMF is contained by the Center Dike and the Main dam embankment.

PMF ELEVATION 416.1 is:

2.1' over low pt. easterly dike
3.1' over spillway boards (normal pool)
4.1' over spillway concrete pad
0.6' over low pt. westerly dike

and

1.1' below center dike low pt.
0.2' below top main dam embankment

½ PMF ≈ 1425 cfs
Elevation 415.55

½ PMF Elevation 415.55 is:

1.55' over low pt. easterly dike
2.55' over spillway boards (normal pool)
3.55' over spillway concrete pad
.05' just overtopping westerly dike

and

1.65' below low pt. center dike
0.75' below top main dam embankment

Storage normal = 1400 ac-ft @ elev. 413
Storage maximum = 1720 ac-ft @ elev. 414
Surface Areas:
At elev. 413 = 316 acres
elev. 414 (maximum storage) = 324 acres
elev. 416.3 (top main dam embankment) = 414 acres
elev. 417.2 (low pt. center dike) = 427 acres

To determine surface areas:

use frustrum of pyramid equation

$$\text{Vol.(acre-feet)} = \frac{1}{3} \cdot h \left(B_1 + B_2 + \sqrt{B_1 B_2} \right)$$

h = elevation above normal pool
B_1 = surface area normal pool (acres)
B_2 = surface area - enlarged (acres)

All parameters are known (determined) except for B_2 — solve for B_2 using quadratic equation $B_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

① AT normal pool el. 413.0 — surface area = 316. acres

② AT pond el. 414.0

volume = 320 acre-feet $= \frac{1}{3} \cdot 1' \left(316 \text{acres} + B_2 + \sqrt{316 B_2} \right)$

$960 = \left(316 + B_2 + \sqrt{316 B_2} \right)$

$644 = B_2 + \sqrt{316 B_2}$

$644 - B_2 = \sqrt{316 B_2}$ (square both sides)

$B_2^2 - 1288 B_2 + 644^2 = 316 B_2$

$B_2^2 - 1604 B_2 + 644^2 = 0$

solve for B_2 using quadratic equation
$a = 1$
$b = -1604$
$c = 644^2$

$$B_2 = \frac{1604 \pm \sqrt{(-1604)^2 - 4 \cdot 1 \cdot 644^2}}{2 \cdot 1}$$

$B_2 = 324$ acres @ el. 414

③ AT pond el. 416.3

volume = 1200 acre-ft = $\frac{1}{3} \cdot 3.3\left(316 + B_2 + \sqrt{316 B_2}\right)$

$1091 = 316 + B_2 + \sqrt{316 B_2}$

$775 - B_2 = \sqrt{316 B_2}$

$B_2^2 - 1550 B_2 + 775^2 = 316 B_2$

$B_2^2 - 1866 B_2 + 775^2 = 0$

$B_2 = 414$ acres @ el. 416.3

④ AT pond el. 415.9

volume = 1050 acre-ft. = $\frac{1}{3} \cdot 2.9\left(316 + B_2 + \sqrt{316 B_2}\right)$

$770 - B_2 = \sqrt{316 B_2}$

$B_2^2 - 1540 B_2 + 770^2 = 316 B_2$

$B_2^2 - 1856 B_2 + 770^2 = 0$

$B_2 = 410$ acres @ el 415.9

⑤ AT pond el. 417.2

volume = 1570 ac-ft = $\frac{1}{3} \cdot 4.2\left(316 + B_2 + \sqrt{316 B_2}\right)$

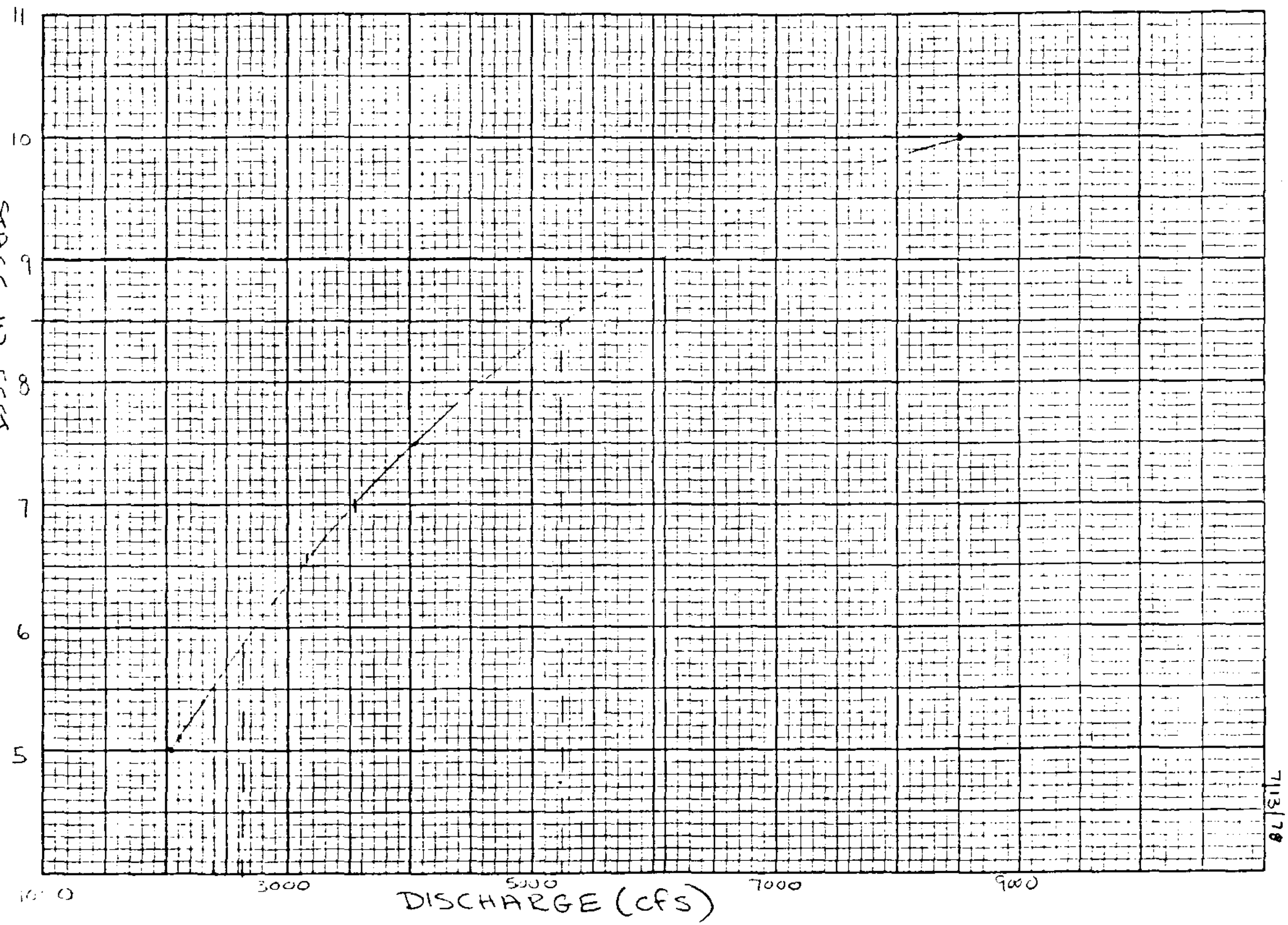
$1121 = 316 + B_2 + \sqrt{316 B_2}$

$805 - B_2 = \sqrt{316 B_2}$

$B_2^2 - 1610.3_2 + 805^2 = 316 B_2$

$B_2^2 - 1946 B_2 + 805^2 = 0$

$B_2 = 427$ acres @ 417.2


STAGE IN FEET
11
10
9
8
7
6
5
3000
5000
7000
9000
DISCHARGE (cfs)
7/13/78

D-15

14/18

D/S Hazard Analysis - using maximum pool elevation of 414 to determine breach discharge.

Storage @ time of failure - 1,720

Step 2: $Q_{p_1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$

W_b = breach width

$g = 32.2 \text{ ft/sec}^2$

y_o = pool elev. - river bed

@ Baxter Lake Easterly Dike

$W_b = 100'$ (1/3 length @ easterly end)

$g = 32.2 \text{ ft/sec}^2$

$y_o = 414 - 408 = 6$

From above equation: $Q = 2471$ cfs

Assume all other structures hold. Since all structures drain into same downstream reach, Q = outflow from other structures + breach Q

2471	- breach Q
166	- stoplog spillway (stoplogs removed)
0	- main dam - gate closed
0	- Westerly dike
0	- Center dike
2637	- total Q

Use the rating curve established from typical section of downstream reach (dike to Route 202A, about 1.9 miles downstream). - Page

Q of 2637 - Stage 5.9'

Reach length = 10031'

Area @ 5.9' stage = 685 ft^2 ⇒ 158 AC-FT

$Q_{p_2} = 2637 \left(1 - \frac{158}{1720}\right)$

$= 2395$ cfs

Stage = 5.5'

Area @ 5.5' stage = 580 ft^2 ⇒ 134 AC-FT

$Q_{p2} = 2637\left(1 - \frac{146}{1720}\right)$
$= 2413$ cfs
Stage 5.6'

@Ten Rod Road - can handle 1000± cfs; would be overtopped

Road Data: Opening - Area = 54 ft²
Length 46'
HW Available = 2.2'
Pipe Arch - 7' rise; 10' span

ORIFICE EQUATION:

$K_f = \frac{29.1(.024)^2 46}{(2)^{4/3}}$ $n = .024$, $L = 46'$, $R = 2.0$

$= 0.31$

Entrance & exit losses ≈ 1.1
∴ Tot K = 1.4
$K = \frac{1}{C^2}$ $1.4 = \frac{1}{C^2}$ $C = 0.85$

$Q = CA\sqrt{2gh}$ $C = 0.85$, $A = 54$, $g = 32.2$, $h = 2.2 + 5 = 7.2$
Assume wsel @ top of road
$Q = 0.85(54)\sqrt{2(32.2 \times 7.2)}$
$Q = 1000 \pm$ cfs

@202A - can handle 3377± cfs - safely pass breach flow.

$K_f = \frac{29.1(.02)^2 32.5}{(3)^{4/3}}$ Area $= 9 \times 18.3 = 165$ ft², $L = 32.5'$, H.W. = 2.4', $n = .02$, $R = \frac{A}{P} = \frac{165}{55} = 3.0$
$= 0.09$

Entrance & exit losses ≈ 1.2
∴ Tot K = 1.3; $K = \frac{1}{C^2} = 1.3 = \frac{1}{C^2} = 0.88$

Assume wsel @ top of road
$Q = CA\sqrt{2gh}$ $C = 0.88$, $A = 165$, $g = 32.2$, $h = 2.4 + 6 = 8.4$
$Q = 0.88(165)\sqrt{2(32.2 \times 8.4)}$
$Q = 3377$ cfs

D/S Hazard Analysis - Using maximum pool (elev. 414 based on easterly dike) to determine breach discharge.
Storage @ time of failure - 1,720

Step 2: $Q_{p_1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$
W_b = breach width
$g = 32.2$ ft/sec^2
y_o = pool elev. - river bed
@ Baxter Lake Main Dam
$W_b = 55'$
$g = 32.2$ ft/sec^2
$y_o = 414 - 403 = 11$
From above equation: $Q = 3374$ cfs
Assume all other structures hold.

3374 - breach Q
166 - stoplog spillway (without stoplogs)
3540 - total breach Q

Use rating curve established from typical section of downstream reach - See page 16

Q - 3540 cfs - Stage = 7.0'
Reach length = 1003'
Area @ 7' stage = 890 ft^2 = 205 AC-FT

$Q_{p_2} = 3540\left(1 - \frac{205}{1720}\right)$
$= 3118$ cfs
Stage = 6.5'
Area @ 6.5' stage = 785 ft^2 = 181 AC-FT

$Q_{p_2} = 3540\left(1 - \frac{193}{1720}\right)$
$= 3143$ cfs
Stage = 6.6'

Ten Rod Road overtopped
Rate 202A - verge of overtopping
For analysis of flow capacity - see page 18.

D/S Hazard Analysis - using maximum pool (elev. 414 based on easterly dike) to determine breach discharge.
Storage at time of failure - 1,720

Step 2: $Q_{p_1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$

W_b = breach width
$g = 32.2$ ft/sec^2
y_o = pool elev. − river bed

@ Baxter Lake Center Dike
$W_b = 80'$ (at left end)
$g = 32.2$ ft/sec^2
$y_o = 414 - 407.7 = 6.3$

From above equation: $Q = 2127$
Total Q:

2127	Center dike breach
166	stoplog spillway
2293	

Use rating curve established from typical section of downstream reach. - See page 16.

Q - 2293 cfs : Stage - 5.4'
Reach length - 10031'
Area @ 5.4' stage - 560 ft^2 = 129 AC-FT

$Q_{p^2} = 2293\left(1 - \frac{129}{1720}\right)$
$= 2121$ cfs
Stage = 5.1' stage - 510 ft^2 = 117 AC-FT

$Q_{p2} = 2293\left(1 - \frac{123}{1720}\right)$
$= 2129$ cfs
Stage = 5.1'

Ten Rod Road overtopped
Route 202A - can handle flow
For analysis of flow capacity see page 18.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
NH	391	NED	NH	017	01				BAXTER LAKE EASTERLY DIKE	4319.3	7102.1	18	AUG	78

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	BAXTER LAKE

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	04	RICKERS BROOK	MEADERBORO CORNER	2	100

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	(27) NORMAL (ACRE–FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REEHCTPG	1923	R	8	8	1720	1400	NED	N	N	N	N	10AUG78

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	(31) MAXIMUM DISCHARGE (FT.)	(32) VOLUME OF DAM (CY)	(33) POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	(34) NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
2	340	N			2500											

(35) OWNER	(36) ENGINEERING BY	(37) CONSTRUCTION BY
HARRY BAXTER	L.E. SCRUTON	

(38) REGULATORY AGENCY			
(39) DESIGN	(40) CONSTRUCTION	(41) OPERATION	(42) MAINTENANCE
NH WATER RES BD	NHWRB	NHWRB	NHWRB

(43) INSPECTION BY	(44) INSPECTION DATE DAY	MO	YR	(45) AUTHORITY FOR INSPECTION
ANDERSON-NICHOLS + COMPANY INC	14	JUN	78	PL 92-367

(46) REMARKS